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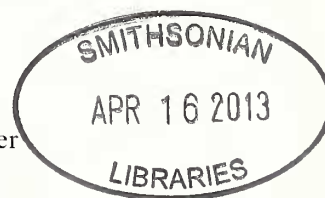
A NEW SPECIMEN OF *PORHOCHELYS* (TESTUDINES: CHELONIOIDEA) FROM THE LATE CRETACEOUS NIOBRARA FORMATION OF KANSAS

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ABSTRACT

The second known specimen, a lower jaw, of the cheloniid turtle *Porthochelys* sp. from the Niobrara Formation of Kansas is described. It is similar to *Porthochelys laticeps* and different from all other cheloniids in the Niobrara Formation in having widely angled dentaries with a blunt anterior end and a comparatively deep profile in lateral view. However, it differs from *Porthochelys laticeps* in having a convex triturating surface that is uniformly wide from the symphysis to the coronoid, and a ventral shelf at the symphysis that is barely exposed in dorsal view. These differences suggest that a second species of *Porthochelys* was present in the Niobrara Formation.

Introduction

Porthochelys Williston 1901, a marine turtle from the Niobrara Formation represented by a single specimen, is one of the most enigmatic Late Cretaceous chelonioids. We describe a second specimen of *Porthochelys*, a lower jaw (MCZ 4104). The mandible is comprised of nearly complete dentaries that were collected in the mid to late 1870s by B. F. Mudge in the Niobrara Formation (Late Cretaceous) in Wallace County, KS. It was donated in 1879 to the Boston Society of Natural History (now the Boston Museum of Science) and catalogued as BSNH 10956. It was later transferred to the Harvard Museum of Comparative Zoology where it was catalogued as *Porthochelys laticeps* Williston 1901. Although this specimen can be included in the genus *Porthochelys* on the basis of several characters shared with the type specimen, differences are present that suggest that MCZ 4104 is specifically distinct. The purpose of this paper is to describe MCZ 4104 and compare it with other cheloniids from the Niobrara Formation. Although taxonomically significant features are present that distinguish it from *Porthochelys laticeps* we refrain from erecting a new species for it pending the discovery of new material that can be placed in stratigraphic position within the formation.

Material Examined

For the purposes of describing MCZ 4104, comparison was made with the following specimens: *Toxochelys latiremis*: MCZ

1046, FMNH PF 124, FMNH UR 3, FMNH UR 96; *Toxochelys browni*: UCMP 45199, UCMP 45200, FMNH PR 648, FMNH PR 659, SDSM 482, SDSM 4614, SDSM 54348, SDSM 56190, USMN 13252, USNM 18279; *Ctenochelys procax*: FMNH UC 614; *Ctenochelys acris*: FMNH PR 97, FMNH PR 444, FMNH PR 1047; *Ctenochelys temista*: FMNH 27339, FMNH PR 1047; *Ctenochelys* sp.: FMNH P 27337, FMNH UC 614, AMNH 6137; *Prionocheilus galeotergum*: UCMP 34533.

Institutional Abbreviations

AMNH, American Museum of Natural History, New York, NY; BSNH, Boston Society of Natural History (now Boston Museum of Science), Boston, MA; KUYV, University of Kansas, Museum of Vertebrate Paleontology, Lawrence, KS; MCZ, Harvard Museum of Comparative Zoology, Cambridge, MA

Systematic Paleontology

Order TESTUDINES Batsch, 1788
Suborder CRYPTODIRA Cope, 1868
Superfamily CHELONOIOIDEA Baur, 1893
Family CHELONIIDAE Bonaparte, 1832
Genus *Porthochelys* Williston, 1901

Type species

Porthochelys laticeps Williston, 1901.

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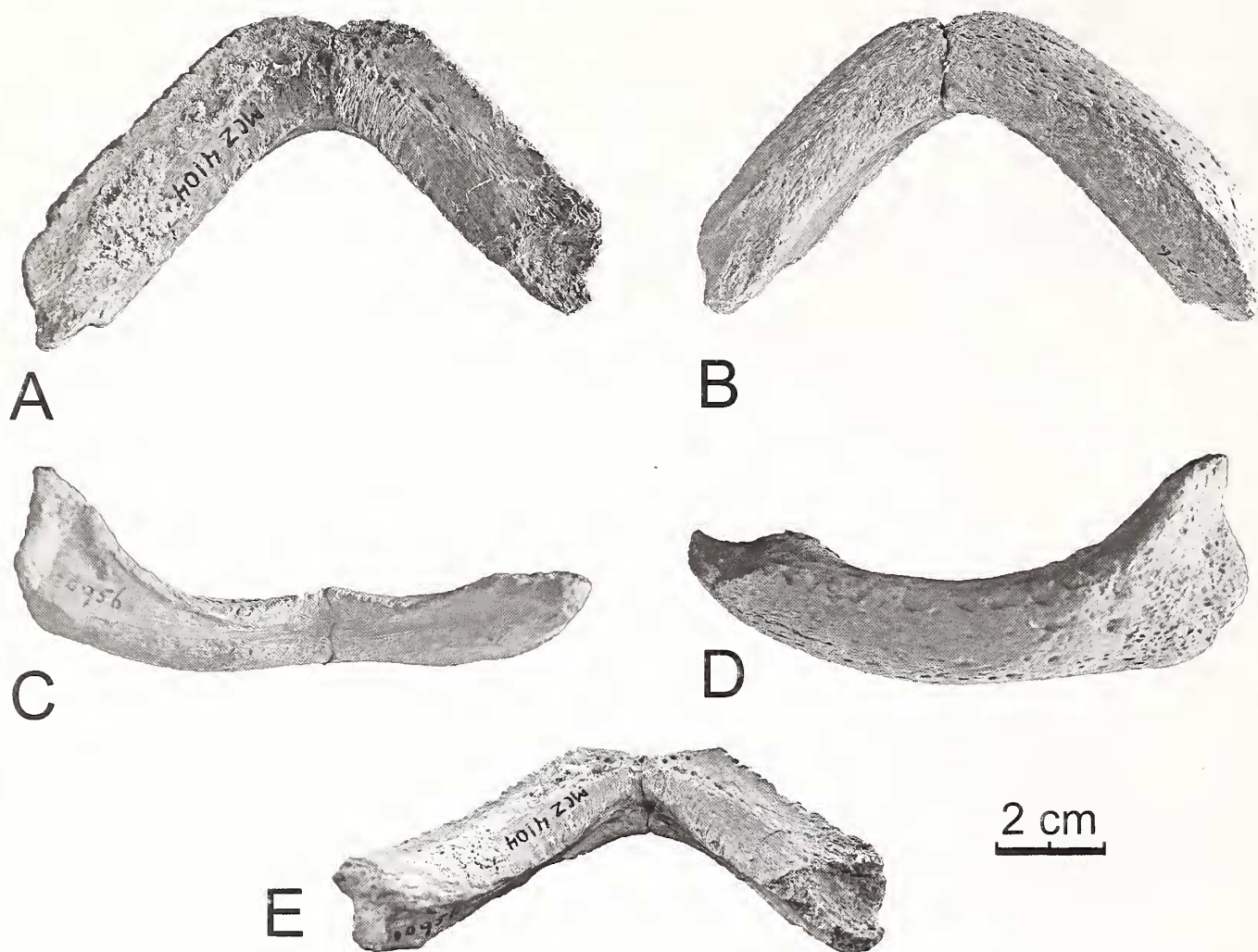


Figure 1. Dentaries of *Porthochelys* sp., MCZ 4104. A, dorsal, B, ventral, C, posterior, D, left lateral view with anterior to the left, and E, dorsoposterior view showing the convex triturating surface and the labial ridge.

Comments

The phylogenetic position of *Porthochelys* has not yet been tested with a cladistics analysis. It is included in the Cheloniodea here because the plastron of *Porthochelys laticeps*, as described by Williston (1901), is chelonioid-like in features that were used by Parham (2005) to distinguish between “macrobaenids” and chelonioids (e.g., the reduced articulation with the bridge and the weak articulation between opposite hyo- and hypoplastron at the midline). As well, the carapace is similar to *Toxochelys* in being circular. However, the phylogenetic position of *Toxochelys* is not resolved. Hirayama (1994) includes *Toxochelys* in the Cheloniidae, while Kear and Lee (2005) conclude that it is basal to the split between cheloniids and protostegids. Pending further study, we include both *Toxochelys* and *Porthochelys* within the Cheloniidae because their plastron is generally similar to that of *Ctenochelys* and different from the plastron of protostegids in that the bridge is narrower and the mid-ventral plastral fenestrae are smaller.

Porthochelys sp.

Figure 1

Referred material

MCZ 4101, anterior portion of mandible consisting of both nearly complete dentaries.

Distribution

Smoky Hill Chalk, Niobrara Formation, upper Coniacian to Lower Campanian. According to the original records, MCZ 4104 was collected in Wallace County in the mid to late 1870s. However, Wallace County was split into two counties, Wallace and St. John counties in 1881, and St. John County was changed to Logan County in 1885 (Elias, 1931). The Smoky Hill Chalk exposures are primarily in what is now Logan County and most of the fossils collected by Mudge and others were likely from these exposures (Bennett, 2000). However, since the exact locality of the specimen is unknown and the Smoky Hill Chalk was deposited over an approximately five million year period, uncertainty regarding the age of the specimen remains.

Description

MCZ 4104 consists of both dentaries (Fig. 1). Both are missing a small portion of the anterior tips, and the posterior portion of the right dentary is also missing. The dentaries are robust, blunt, and broad, forming an angle of approximately 90°. The overall length of the conjoined dentaries measured along the midline is 6 cm. The length of the left dentary measured along its long axis is 7 cm. The width between the ends of the dentaries is 10.5 cm.

Table 1. Comparison of dentaries from Cheloniidae of the Niobrara Formation.

	<i>Porthochelys laticeps</i>	MCZ 4104	<i>Toxochelys latiremis</i>	<i>Ctenochelys stenopora</i>	<i>Ctenochelys procax</i>	<i>Prionocheilus galeotergum</i>
Size	Large, robust	Large, robust	Large, gracile	Large, gracile	Large, gracile	Large, gracile
Rami angle	Wide (90°)	Wide (90°)	Narrow (60°)	Narrow (60°)	Narrow (60°)	Narrow (60°)
Coronoid contact	Rises sharply	Rises sharply	Shallow	Shallow	Shallow	Shallow
Triturating surface width	Wide posteriorly, narrower at symphysis	Uniformly wide	Narrow posteriorly, wider at symphysis	Wide at symphysis, narrowing posteriorly;	Wide at symphysis, narrowing posteriorly	Wide at symphysis, narrowing posteriorly
Tip	Blunt	Blunt	Pointed	Pointed	Pointed	Pointed
Depth	Thick	Thick	Thin	Thin	Thin	Thin
Triturating surface	Flat	Convex	Flat	Flat	Flat	Flat
Symphysial Ridge	Present	Present	Absent	Present	Present	Present
Symphysis: visibility of ventral shelf in dorsal view	Highly visible	Not visible	Visible	Not visible	Not visible	Not visible

Thus, this specimen is slightly larger than *Porthochelys laticeps*, which is 9 cm across the posterior end of the dentary. The symphysis is short and bears a small sagittal ridge. The ventral shelf is barely visible in dorsal view posterior to the triturating surface (Fig. 1A). A low labial ridge is present but a distinct lingual ridge is absent. The triturating surface of the left dentary is partially obscured by adhering matrix, but this surface is fully exposed on the right dentary. The surface is relatively narrow with a uniform width of 2 cm for most of its length. The triturating surface is unusual for chelonians in being convex as a result of the presence of a wide ridge extending from the symphysis along the center of the triturating surface to the point where the dentary rises to meet the coronoid (Fig. 1E).

In medial view, the *sulcus cartilagineus meckeli* is deep and narrow anteriorly, becoming broader and shallower posteriorly. The ventral surfaces are convex. The lateral side is ornamented with small foramina that extend almost to the posterior margin, suggesting the dentary was almost entirely covered by a beak.

Discussion

In the latest review of turtles of the Niobrara Formation (Zangerl, 1953), seven non-protostegid chelonians are recognized in the formation: *Porthochelys laticeps*, *Toxochelys latiremis* Cope, 1873, *Ctenochelys stenopora* (Hay, 1905), *Ctenochelys procax* (Hay, 1905), and *Prionocheilus galeotergum* Zangerl, 1953, *Lophochelys natatrix* Zangerl, 1953, and *Cynocerus incisivus* Cope 1872. The validity of *Lophochelys* was questioned by Hirayama (1997), who suggested that it was a grouping of juveniles of other taxa. In an earlier paper, Hirayama (1994) includes the holotype specimen of *Lophochelys natatrix* in a list of specimens of *Ctenochelys stenopora*. We follow Hirayama (1994, 1997) in considering *Lophochelys natatrix* to be a juvenile individual of *Ctenochelys stenopora*. *Cynocerus incisivus* Cope 1872, which is only represented by caudal vertebrae, is considered a *nomen vanum* since chelonians cannot be distinguished on the basis of caudal vertebrae. All of the five chelonians from the Niobrara Formation are represented by dentaries.

Differences between the dentary of the chelonians present in the Niobrara Formation and that of MCZ 4104 are listed in Table 1. MCZ 4104 is referred to *Porthochelys* because it shares three characters with *Porthochelys laticeps* that distinguish them from all other members of the Cheloniidae in the Niobrara Formation (Fig. 2, Table 1). One of these is the shape of the jaw as seen in dorsal view. The rami of the lower jaw are widely angled, the anterior end of the jaw is blunt, and the dentary has a

comparatively deep profile in lateral view. In the mandibles of *Toxochelys*, *Ctenochelys*, and *Prionocheilus* the angle formed by the dentaries is only 60° while in MCZ 1046 and the type specimen it is nearly 90°. Secondly, MCZ 4104 and the type specimen of *Porthochelys* also differ from *Toxochelys*, *Ctenochelys*, and *Prionocheilus* in that the triturating surface rises sharply at the posterior end of the dentary towards the coronoid. The third feature distinguishing MCZ 4104 from the remaining chelonians is the shape of the triturating surface. The triturating surface of MCZ 4104 and the type specimen of *Porthochelys* are similar to that of *Ctenochelys* and *Prionocheilus* and different from *Toxochelys latiremis* in being relatively broad, and differ from *Ctenochelys* and *Prionocheilus* in that the surfaces are wide posteriorly. In *Ctenochelys* and *Prionocheilus* the triturating surface narrows posteriorly.

Specimen MCZ 4104 differs from the type specimen of *Porthochelys laticeps* in three characters that are of potential taxonomic significance. Firstly, the presence of a convex triturating surface. In *Porthochelys laticeps*, this surface is distinctly concave (Williston, 1901), the typical condition for basal chelonians. Secondly, the triturating surface in MCZ 4104 is uniformly wide from the symphysis to the coronoid contact, but is relatively narrower at the symphysis than at the coronoid in the type specimen of *P. laticeps*. Thirdly, the structure of the symphysis as seen in dorsal view; in MCZ 4104 the ventral shelf is barely visible in dorsal view but it is prominently exposed in *P. laticeps*. Although the three described differences may represent autapomorphies that could support a new taxon, we refrain from erecting a species at this time, and thus refer the dentary to *Porthochelys* sp.

With the recognition of a second species of *Porthochelys* the number of chelonians present in the Niobrara Formation is increased to six. However, since the exact locality from which the jaw was collected is not known, the age of the specimen relative to the type specimen of *Porthochelys laticeps* is uncertain. The type specimen of *Porthochelys laticeps* was collected along the Saline River in Trego County, KS, relatively low in the chalk (Late Coniacian). Since the Smoky Hill Member extends from the upper Coniacian to the lower Campanian there may be a considerable difference in the age of the two specimens. Exposures in Logan County, tend to be stratigraphically higher in the formation (Bennett, 2000), so it is likely that *Porthochelys* sp. is younger than *Porthochelys laticeps*. However, additional specimens that can be placed in stratigraphic context are required to firmly establish whether or not these species represent successive species of the

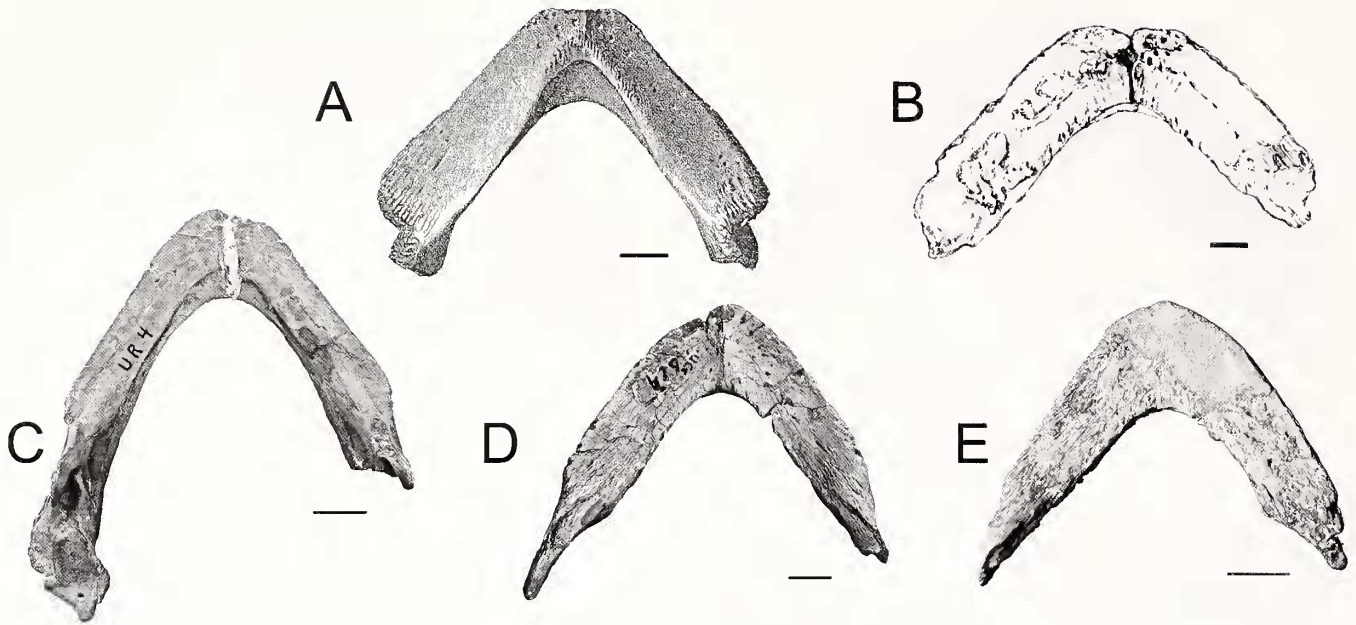


Figure 2. Comparison of specimen MCZ 4104 with dentaries of cheloniids from the Niobrara Formation. A, *Porthochelys laticeps*, type specimen, from Williston (1901). B, *Porthochelys* sp., MCZ 4014, drawing in dorsal view. C, *Toxochelys latiremis*, subadult, FMNH UR 4. D, *Ctenochelys procax*, FMNH UC 614. E, *Prionocheilus galeotergum*, UCMP 34533. All in dorsal view. Scale bar equals 1 cm.

genus *Porthochelys* and to determine the stratigraphic range of these species.

Acknowledgments

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